

## 2.14 CONSTRUCTION METHODOLOGY

*WAC 463-42-255 Proposal – Construction methodology. The applicant shall describe in detail the construction procedures, including major equipment, proposed for any construction activity within watercourses, wetlands and other sensitive areas.*

### 2.14.1 Introduction

In general, the Project's wind turbines, site roads, underground cables, and other supporting infrastructure are located on the higher ridge tops with good wind exposure and not in wetlands or watercourses. Environmental mitigation activities include the installation of erosion, drainage, and storm water systems along disturbed slopes. No special water rerouting or dewatering is required for construction. Several pieces of large construction equipment will be required to complete Project construction as described in each of the sections below regarding the specific phase and discipline of construction.

The construction of the Kittitas Power Project will be performed in a manner that will incorporate the impact mitigation methods outlined in other sections of this application, including, but not limited to erosion control measures (see Section 3.1, 'Earth'); emission controls (see Section 3.2, 'Air'); surface-water control measures (see Section 2.10, 'Surface Water Runoff' And Section 3.3, 'Water'); spillage prevention and control measures (see Section 2.9, 'Spillage Prevention and Control'); environmental health mitigation measures (see Section 4.1, 'Environmental Health'); traffic control measures (see Section 5.2, 'Transportation'); and other construction practice measures (see Section 5.3, 'Public Services And Utilities') that will minimize the Project's impact on the environment and the surrounding area.

Project construction will be performed in several stages and will include the following main elements and activities:

- Grading of the field construction office and substation areas (also used for O&M building);
- Construction of site roads, turn-around areas and crane pads at each wind turbine location;
- Construction of the turbine tower foundations and transformer pads;
- Installation of the electrical collection system – underground and some overhead lines;
- Assembly and erection of the wind turbines;
- Construction and installation of the substation;
- Plant commissioning and energization.

The Applicant intends to enter into two primary agreements for the construction of the Project including an agreement for the supply, erection and commissioning of the wind turbines as well as an Engineering, Procurement and Construction (EPC) contract for the construction of the balance of plant (BOP) which includes all other Project facilities and infrastructure such as the roads, electrical collection system, substation, O&M Facility, etc. The turbine supplier and the EPC Contractor will be selected during the EFSEC application review process.

### 2.14.2 Existing Conditions

The Project will be located on open rangeland which is zoned as Ag-20 and Forest & Range by Kittitas County. The Project area has undergone thorough examination by wildlife and plant biologists to map and study the types of areas that will be disturbed by Project construction. An aerial view of the Project site layout is contained in Exhibit 2 which illustrates the type of overall land types and proximity of the

Project facilities to slopes and creek beds. The Project site is predominantly grassland and sparse to moderate shrub steppe with thin soil coverage due to high wind erosion and exposed fractured basalt. No wetlands or known jurisdictional waters have been identified where Project facilities will be constructed.

## **2.14.3 Construction Procedures**

### **2.14.3.1 Engineering, Surveying and Design Specifications**

#### **2.14.3.1.1 Field Survey and Geotechnical Investigations**

Before construction can commence, a site survey will be performed to stake out the exact location of the wind turbines, the site roads, electrical cables, access entryways from public roads, substation areas, etc.

Once the surveys are complete, a detailed geotechnical investigation will be performed to identify subsurface conditions which will dictate much of the design work of the roads, foundations, underground trenching and electrical grounding systems. Typically, the geotechnical investigation involves a drill rig which bores to the engineer's required depths (typically 8 inch diameter drill to 30-40 feet deep) and a backhoe to identify the subsurface soil and rock types and strength properties by sampling and lab testing. Testing is also done to measure the soil's electrical properties to ensure proper grounding system design. A geotechnical investigation is generally performed at each turbine location, at the substation location and at the O&M building location.

#### **2.14.3.1.2 Design and Construction Specifications**

Using all of the data that has been gathered for the Project including geotechnical information, environmental and climatic conditions, site topography, etc. applicant's engineering group will establish a set of site-specific construction specifications for the various portions of the Project. The design specifications are based on well proven and established sets of construction standards set forth by the various standard industry practice groups such as the American Concrete Institute (ACI), Institute for Electrical and Electronic Engineers (IEEE), National Electric Code (NEC), National Fire Protection Agency (NFPA), and Construction Standards Institute (CSI), etc. The design and construction specifications are custom tailored for site-specific conditions by technical staff and engineers. The Project engineering team will also ensure that all aspects of the specifications as well as the actual on-site construction comply with all of the applicable federal, state and local codes and good industry practice.

Equipment procurement will also be undertaken using the Project site specifications. The primary EPC Contractor will use the design specifications as a guideline to complete the detailed construction plans for the Project. The design basis approach ensures that the Project will be designed and constructed to meet the minimum 20 year design life.

### **2.14.3.2 Site Preparation and Road Construction**

Construction activities will begin with site preparation, including the construction of Project site access entry ways from public roads, rough grading of the roads, leveling of the field construction site office parking area and the installation of about 6 to 8 temporary site office trailers with

temporary power adjacent to the PSE substation area on the northwest corner of Bettas Road and Highway 97 as shown on the Project Site Layout in Exhibit 1.

The Project roads will be gravel surfaced and generally designed with a low profile without ditches to allow storm water pass over top. Road construction will be performed in multiple passes starting with the rough grading and leveling of the roadway areas. Once rough grade is achieved, base rock will be trucked in, spread and compacted to create a road base. A capping rock will then be spread over the road base and roll-compacted to finished grade.

Once heavy construction is complete, a final pass will be made with the grading equipment to level-out road surfaces and more capping rock will be spread and compacted in areas where needed. Water bars, similar to speed bumps, will be cut in to the roads in areas where needed to allow for natural drainage of water over the road surface and to prevent road washout. This will be done in accordance to a formal storm water pollution prevention plan for the Project as outlined in Section 2.10, 'Surface Water Runoff'.

The Project is located on open agricultural and forest and rangeland. Excavated soil and rock that arises through grading will be spread across the site to the natural grade and will be reseeded with native grasses to control erosion by water and wind. Larger excavated rocks will be disposed of off-site or crushed and re-used on-site as backfill or roadway material.

Project road construction will involve the use of several pieces of heavy machinery including bulldozers, track-hoe excavators, front-end loaders, dump trucks, motor graders, water trucks and rollers for compaction. Storm water controls, such as hay bales and diversion ditches in some areas will control storm water runoff during construction. Access from public roads will have locked gates as agreed upon with the landowners.

#### **2.14.3.3 Foundation Construction**

The Project will require several foundations including bases for each turbine and pad transformer, the substation equipment and the O&M facility. Often, separate subcontractors are mobilized for each type of foundation they specialize in constructing.

Once the roads are complete for a particular row of turbines, turbine foundation construction will commence on that completed road section. Foundation construction occurs in several stages including drilling, blasting and hole excavation, outer form setting, rebar and bolt cage assembly, casting and finishing of the concrete, removal of the forms, backfilling and compacting, construction of the pad transformer foundation, and foundation site area restoration.

Excavation and foundation construction will be conducted in a manner that will minimize the size and duration of excavated areas required to install foundations. Portions of the work may require over excavation and/or shoring. Foundation work for a given excavation will commence after excavation of the area is complete. Backfill for the foundations will be installed immediately after approval by the engineer's field inspectors. The Applicant plans on using on-site excavated materials for backfill to the extent possible.

Based on preliminary calculations and depending on the type of foundation design used, approximately 125 cubic yards of excavated soil will remain from each turbine foundation excavation. The excess soils not used as backfill for the foundations will be used to level out low spots on the crane pads and roads consistent with the surrounding grade and reseeded with a designated mix of grasses and/or seeds around the edges of the disturbed areas. Larger cobbles will be disposed of off-site, or crushed into smaller rock for use as backfill or road material. All

excavation and foundation construction work will be done in accordance to a formal Storm Water Pollution Prevention Plan (SWPPP) for the Project as outlined in Section 2.10, 'Surface Water Runoff'.

The foundation work requires the use of several pieces of heavy machinery including track-hoe excavators, drill rigs, front-end loaders, dump trucks, transportation trucks for materials, cranes and boom trucks for off-loading and assembly, compactors, concrete trucks, concrete pump trucks, backhoes and small Bob-Cat type loaders.

#### **2.14.3.4 Electrical Collection System Construction**

Once the roads and turbine foundations and transformer pads are complete for a particular row of turbines, underground cables will be installed on that completed road section. First of all, a trench is cut to the required depth with a rock trencher. Due to the rocky conditions at the site, clean fill will be placed above and below the cables for the first several inches of fill to prevent cable pinching. All cables and trenches are inspected before backfilling. Once the clean fill is covering the cables, the excavated material is then used to complete the backfilling. In areas where solid rock is encountered close to the surface, blasting will be done or a shallower trench will be cut using rock cutting equipment and the cables will be covered with a concrete slurry mix to protect the cables and comply with code and engineering specifications.

The high voltage underground cables are fed through the trenches and into conduits at the pad transformers at each turbine. The cables run to the pad transformers' high voltage (34.5 kV) compartment and are connected to the terminals. Low voltage cables are fed through another set of underground conduits from the pad transformer to the bus cabinet inside the base of the wind turbine tower. The low voltage cable will be terminated at each end and the whole system will be inspected and tested prior to energization.

The two short runs of overhead pole line will require a detailed field survey to determine the exact pole locations. Once the survey and design work are done, the installation of poles and cross-arms to support the conductors can commence. The poles are first assembled and fitted with all of their cross-arms, cable supports and insulator hardware on the ground at each pole location. Holes for each pole will then be excavated or drilled and the poles will be erected and set in place using a small crane or boom truck. Once it is set in place, concrete will be poured in place around the base of the tower, or a clean fill will be compacted around the tower base according to the engineer's specifications. The overhead lines will connect to underground cables at each end through a switchable, visible, lockable riser disconnect with fuses.

Excavated soil and rock that is not reused in backfilling the trenches will be spread across the site to the natural grade to be reseeded with native grasses to control erosion by water and wind. Larger excess excavated rocks will be disposed of off-site. All excavation, trenching and electrical system construction work will be done in accordance to a formal Storm Water Pollution Prevention Plan (SWPPP) for the Project as outlined in Section 2.10, 'Surface Water Runoff'.

The electrical construction work will require the use of several pieces of heavy machinery including a track-hoe, a rock trencher, rock cutting equipment, front-end loaders, drill rigs for the pole-line, dump trucks for import of clean back fill, transportation trucks for the materials, small cranes and boom trucks for off-loading and setting of the poles and pad transformers, concrete trucks, cable spool trucks used to un-spool the cable, man-lift bucket trucks for the pole-line work and a winch truck to pull the cable from the spools onto the poles.

#### **2.14.3.5 Substation and Interconnect and Construction**

The construction schedule for the substation and interconnection facilities is largely dictated by the delivery schedule of major equipment such as the main transformers, breakers, capacitors, outdoor relaying equipment, the control house, etc.

The utility (PSE or BPA) is generally responsible for the construction of the interconnection facilities, as they will remain under utility control and jurisdiction. Generally, the high-side of the substation remains under the control of the utility and the low-side of the substation generally belongs to the Project. A fence may be installed between the high and low voltage sections to maintain clarity and there will likely be 2 control houses: One for the utility high side relaying and interconnection facilities controls and one for the Project substation low-side relaying and controls.

The substation and interconnection facilities construction involves several stages of work including, but not limited to, grading of the area, the construction of several foundations for the transformers, steel work, breakers, control houses, and other outdoor equipment, the erection and placement of the steel work and all outdoor equipment, and electrical work for all of the required terminations. All excavation, trenching and electrical system construction work will be done in accordance to a formal Storm Water Pollution Prevention Plan (SWPPP) for the Project as outlined in Section 2.10, 'Surface Water Runoff'. Once physical completion is achieved a rigorous inspection and commissioning test plan is executed prior to energization of the substation.

The substation and interconnection facilities construction work requires the use of several pieces of heavy machinery including a bulldozer, drill rig and concrete trucks for the foundations, a trencher, a back-hoe, front-end loaders, dump trucks for import of clean back fill, transportation trucks for the materials, boom trucks and cranes for off-loading of the equipment and materials, concrete trucks for areas needing slurry backfill, man-lift bucket trucks for the steel work and pole-line work, etc.

#### **2.14.3.6 Wind Turbine Assembly and Erection**

The wind turbines consist of 3 main components: the towers, the nacelles (machine house) and the rotor blades. Other smaller components include hubs, nose cones, cabling, control panels and tower internal facilities such as lighting, ladders, etc. All turbine components will be delivered to the Project site on flatbed transport trucks and main components will be off-loaded at the individual turbine sites.

Turbine erection is performed in multiple stages including: setting of the bus cabinet and ground control panels on the foundation, erection of the tower (usually in 3-4 sections), erection of the nacelle, assembly and erection of the rotor, connection and termination of the internal cables, and inspection and testing of the electrical system prior to energization.

Turbine assembly and erection involves mainly the use of large truck or track mounted cranes, smaller rough terrain cranes, boom trucks, rough terrain fork-lifts for loading and off-loading materials and equipment, flat bed and low-boy trucks for transporting materials to site.

#### **2.14.3.7 Plant Energization and Commissioning (Start-Up)**

Plant commissioning follows mechanical completion of the Project, and it does not require the use of heavy construction machinery.

#### **2.14.3.8 Project Construction Clean-Up**

Since Project clean up generally consists of landscaping and earthwork, it is very weather and season sensitive. Landscaping clean up is generally completed during the first allowable and suitable weather conditions after all of the heavy construction activities have been completed. Disturbed areas outside of the graveled areas will be reseeded to control erosion by water and wind. All construction clean-up work and permanent erosion control measures will be done in accordance to a formal Storm Water Pollution Prevention Plan (SWPPP) for the Project as outlined in Section 2.10, 'Surface Water Runoff'.

Other Project clean-up activities might include interior finishing of the O&M building, landscaping around the substation area, washing of towers, painting of scratches on towers and exposed bolts as well as other miscellaneous tasks that are part of normal construction clean-up.

Construction clean-up will require the use of a motor grader, dump trucks, front-end loaders, and light trucks for transportation of any waste materials, packaging, etc.